



BACTERIOLOGICAL WATER QUALITY OF BALSAM LAKE

by

Allan Burger

Bacteriology Branch
Division of Laboratories
ONTARIO WATER RESOURCES COMMISSION

March, 1971

MOE
BAL
BAC
ANTD

..*
a aa

Copyright Provisions and Restrictions on Copying:

This Ontario Ministry of the Environment work is protected by Crown copyright (unless otherwise indicated), which is held by the Queen's Printer for Ontario. It may be reproduced for non-commercial purposes if credit is given and Crown copyright is acknowledged.

It may not be reproduced, in all or in part, for any commercial purpose except under a licence from the Queen's Printer for Ontario.

For information on reproducing Government of Ontario works, please contact ServiceOntario Publications at copyright@ontario.ca

BACTERIOLOGICAL WATER QUALITY OF BALSAM LAKE

by

Allan Burger

Bacteriology Branch
Division of Laboratories
ONTARIO WATER RESOURCES COMMISSION

March, 1971

and

Abstract

Through the two intensive bacteriological surveys of Balsam Lake, two very different pictures of the water quality of the lake were presented. The preseason survey showed a lake which was unpolluted and completely acceptable for recreational use. The mid-season survey showed a lake which was fecally polluted to the point of being unacceptable for recreational use. In this latter case, sufficient information was obtained to indicate a public health hazard but insufficient to indicate, with certainty, sources or degrees of pollution.

Introduction

During the summer of 1970, two intensive bacteriological surveys were conducted on Balsam Lake located in Victoria County on the Trent Canal system. This roughly H-shaped lake is about nine miles long and four miles wide with a large one mile diameter island, Grand Island, located at its middle. The lake receives water from the north through the Gull River and from a number of smaller streams around the lake. The main outflow from Balsam Lake is through the Rosedale River and Lock 35 of the Trent Canal to Cameron Lake, but there is a small flow from the lake via the unnatural water passage presented through Lock 36 to Mitchell Lake.

The lake is well developed with cottages along most shores except for the Grand Island shoreline, the east side of Indian Point along the Gull River, and a number of sections of South Bay shoreline. Balsam Lake Provincial Park is located on the west shore of North Bay. The town of Coboconk is upstream of Balsam Lake on the Gull River; while the town of Rosedale is located on the Rosedale River, the outflow of Balsam Lake.

Methods

During the preseason survey, June 8 to 12, 1970, 33 stations were sampled. Samples from all stations received analysis for total coliform (TC) and fecal coliform (FC); while samples from 20 of the stations were additionally analyzed for fecal streptococcus (FS).

During the second or mid-season survey, August 17 to 21, 1970, 35 stations were sampled. All samples were analyzed for the three parameters. During this survey the mobile laboratory used to analyze the samples was located at Lock 35 near Rosedale. At this location a problem of contamination of the water supply (all water at the lockhouse was drawn directly from the canal with little or no treatment) was encountered. This resulted in contamination of some of the analyses and a negation of results obtained from these analyses.

All samples taken on Balsam Lake were surface samples. Samples were taken in sterile 250 ml autoclavable polycarbonate bottles from approximately one metre below the water surface. Analysis of the samples was begun usually 2 to 6 hours after sampling.

Statistical evaluation of the results of the surveys was based on the geometric means of the bacterial counts. Geometric means for stations were compared to each other on the basis of geographic location, bacterial level and the variation in count (95% confidence limits). At the same time all geometric means were compared to the water quality criteria for total body contact recreation as set forth in the OWRC "Guidelines and Criteria for Water Quality Management in Ontario" (June 1970).

The station location and the parametric geometric means for each station are presented in Figures 1 and 2.

Discussion and Results

In the preseason survey all bacterial levels were well below the recreational water quality criteria with maximum geometric means of 45 TC/100 ml, 24 FC/100 ml and 15 FS/100 ml.

In the mid-season survey all bacterial parameters changed dramatically from the first survey. Most stations presented TC levels in excess of the recreational water quality criteria (geometric mean of 1000 TC/100 ml). Only seven stations of thirty-five were lower than the criteria and in each case at least one sample exceeded 1000 TC/100 ml.

The FC levels showed fewer stations (seven of thirty-five) which were unacceptable according to the recreational water quality criteria. But in almost all cases, some sample counts from each station exceeded 100 FC/100 ml. The FS water quality criteria was not exceeded at any station and only a few high counts were recorded.

The stations in South Bay and the lower part of West Bay showed slightly better water quality than the rest of the lake. However, high individual TC and FC counts were recorded at these stations. These areas have less development which might account for the lower bacterial pollution. But the counts which were recorded indicated a sporadic bacterial pollution of the area.

The FC parameter indicated that

- (1) the Gull River south of the town of Coboconk (station 6),
- (2) the lake off Cedar Villa lodge (station 1),
- (3) an area near Grand Island (station 34),
- (4) the shoreline north of Balsam Lake Provincial Park (station 12) and
- (5) the lake in between McKenzie Point, Indian Point and Grand Island (stations 9, 14 and 15)

are the particularly bad areas of the lake. But because of the shortness of the survey (5 days) and the loss of some data through contamination of analysis, sufficient

information was not obtained to indicate relative pollution within this group of areas or over the rest of the lake.

Climatic conditions which might have influenced the bacterial levels had a minor role in these surveys. Maps of the area indicate swamps or marsh conditions in the watershed around Balsam Lake. This condition could account for some of the TC concentrations but not the high FC levels.

The low bacterial concentrations in the preseason survey indicates that the lake probably recovers quickly from the pollution load which is placed on it during the height of the recreational season. But trends during or between surveys did not develop to aid further interpretation of the data.

Therefore, on the basis of high TC levels and high, variable FC levels during the mid-season survey, Balsam Lake was unacceptable for total body contact recreational use.

Recommendations

1) If the aim of the bacteriological survey of a lake is to obtain an optimum amount of information for interpreting sources and trends of bacterial pollution in a lake, consideration should be given not only to the length of a survey but also to the length of time interval between surveys.

In the case of the surveys on Balsam Lake, the two months time separation of surveys was too long and resulted in two completely different pictures.

2) In considering the duration of a survey, allowance should be made for loss of data through laboratory accidents or other mishaps.

3) When locating the mobile laboratory facility, the source and treatment of the water supply should be determined and laboratory procedures adjusted accordingly.

FIGURE 1

BALSAM
LAKE

1st Survey
June 8 - 12, 1970

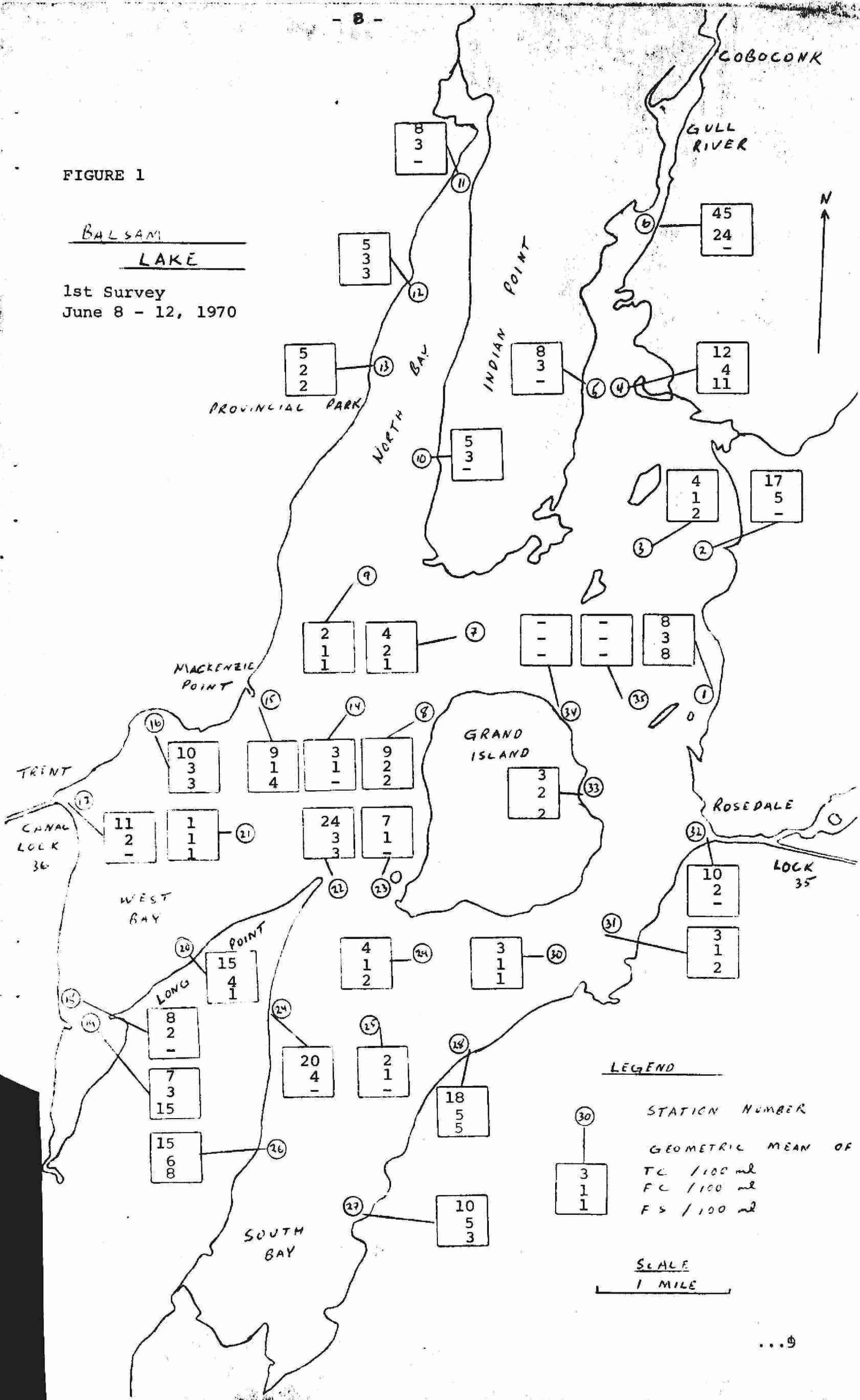


FIGURE 2

BALSAM
LAKE

2nd Survey
August 17-21, 1970

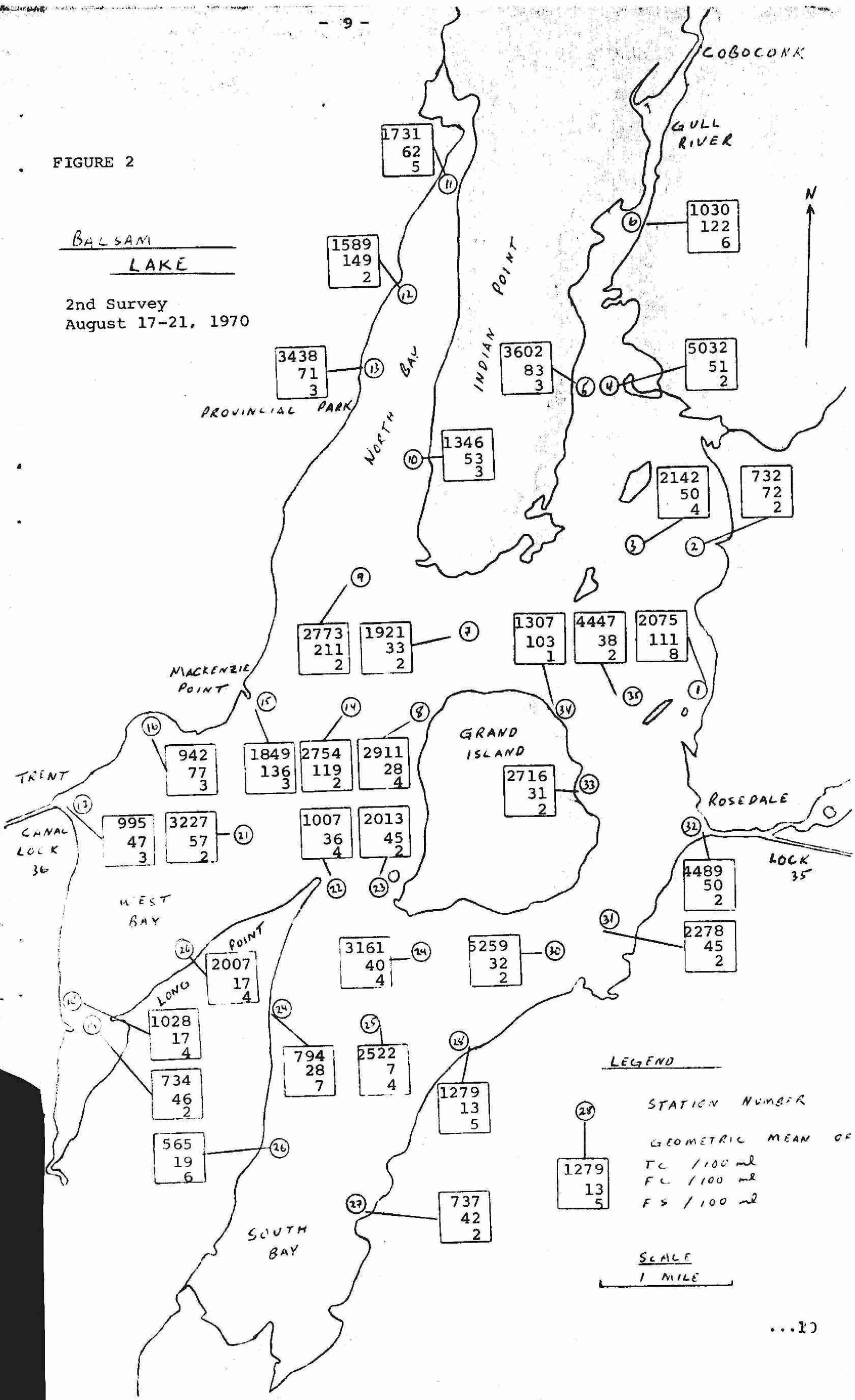


TABLE 1: SURVEY SUMMARY

Lake: Balsam

Date: June 8 - 12, 1970

Survey: 1st

<u>Station</u>	<u>Parameter</u>	<u>No.</u>	<u>GM/100 ml</u>	<u>UL</u>	<u>LL</u>
B1M	TC	5	7.9	29.1	2.1
	FC	5	2.9	9.9	0.9
	FS	5	7.6	61.0	0.9
	TPC	5	2978.	7776.	1141.
B2	TC	5	16.7	91.2	3.0
	FC	5	4.5	27.4	0.7
B3M	TC	5	4.1	12.6	1.3
	FC	5	1.3	2.1	0.8
	FS	5	1.7	7.3	0.4
	TPC	5	979.	1889.	507.
B4M	TC	5	11.6	28.5	4.7
	FC	5	4.0	20.1	0.8
	FS	5	10.5	60.5	1.8
	TPC	5	2393.	4558.	1256.
B5	TC	5	8.0	23.2	2.7
	FC	5	3.2	18.6	0.6
B6	TC	5	45.1	137.3	14.8
	FC	5	23.6	64.6	8.6
B7M	TC	5	3.9	14.6	1.1
	FC	5	1.6	4.3	0.6
	FS	5	1.1	1.7	0.8
	TPC	5	900.	1544.	524.
B8M	TC	5	8.5	33.4	2.2
	FC	5	1.8	6.3	0.5
	FS	5	2.3	9.3	0.6
	TPC	5	926.	2931.	293.
B9M	TC	5	1.7	3.6	0.8
	FC	5	1.1	1.7	0.8
	FS	5	1.0	1.0	1.0
	TPC	5	819.	3546.	189.

Lake: Balsam

Date: June 8 - 12, 1970

Survey: 1st

<u>Station</u>	<u>Parameter</u>	<u>No.</u>	<u>GM/100 ml</u>	<u>UL</u>	<u>LL</u>
B10	TC	5	5.0	38.7	0.7
	FC	5	2.9	15.6	0.5
B11	TC	5	7.7	41.9	1.4
	FC	5	2.5	7.2	0.9
B12M	TC	5	4.9	25.7	0.9
	FC	5	2.5	5.9	1.1
	FS	5	3.1	22.1	0.4
	TPC	5	1502.	8688.	260.
B13M	TC	5	4.9	18.7	1.3
	FC	5	1.5	3.3	0.7
	FS	5	1.6	6.5	0.4
	TPC	5	1324.	4057.	432.
B14	TC	5	2.6	5.7	1.2
	FC	5	1.3	2.8	0.6
B15M	TC	5	9.0	65.3	1.2
	FC	5	1.1	1.7	0.8
	FS	5	4.4	29.4	0.7
	TPC	5	1391.	2693.	719.
B16M	TC	5	10.0	51.0	2.0
	FC	5	3.3	15.7	0.7
	FS	5	2.7	10.7	0.7
	TPC	5	1772.	5768.	545.
B17	TC	5	10.5	37.9	2.9
	FC	5	2.3	5.9	0.9
B18	TC	5	7.6	36.3	1.6
	FC	5	2.0	13.7	0.3
B19M	TC	5	6.5	17.5	2.4
	FC	5	2.5	9.2	0.7
	FS	5	14.8	130.4	1.7
	TPC	5	1392.	1616.	1199.

Lake: Balsam

Date: June 8 - 12, 1970

Survey: 1st

<u>Station</u>	<u>Parameter</u>	<u>No.</u>	<u>GM/100 ml</u>	<u>UL</u>	<u>LL</u>
B20	TC	5	15.0	84.9	2.6
	FC	5	4.1	31.8	0.5
B21M	TC	5	1.0	1.0	1.0
	FC	5	1.1	1.7	0.8
	FS	5	1.0	1.0	1.0
	TPC	5	198.	387.	102.
B22M	TC	5	24.3	214.8	2.7
	FC	5	2.5	15.0	0.4
	FS	5	3.2	16.3	0.6
	TPC	5	1345.	5106.	355.
B23	TC	5	6.7	41.6	1.1
	FC	5	1.3	2.1	0.8
B24	TC	5	20.0	36.1	11.1
	FC	5	3.8	13.3	1.1
B25	TC	5	2.3	4.7	1.1
	FC	5	1.3	2.8	0.6
B26M	TC	5	15.0	83.7	2.7
	FC	5	5.6	43.2	0.7
	FS	5	7.6	82.4	0.7
	TPC	5	1461.	4546.	469.
B27M	TC	5	9.8	89.9	1.1
	FC	5	4.7	32.7	0.7
	FS	5	3.0	19.9	0.5
	TPC	5	1952.	6398.	596.
B28M	TC	5	18.4	47.9	7.0
	FC	5	5.2	31.0	0.9
	FS	5	5.1	19.1	1.4
	TPC	5	2110.	3953.	1126.

Lake: Balsam

Date: June 8 - 12, 1970

Survey: 1st

<u>Station</u>	<u>Parameter</u>	<u>No.</u>	<u>GM/100 ml</u>	<u>UL</u>	<u>LL</u>
B29M	TC	5	4.1	12.5	1.3
	FC	5	1.0	1.0	1.0
	FS	5	1.5	2.4	0.9
	TPC	5	443.	1257.	156.
B30M	TC	5	2.6	4.2	1.6
	FC	5	1.1	1.7	0.8
	FS	5	1.4	3.9	0.5
	TPC	5	352.	652.	190.
B31M	TC	5	3.3	9.4	1.2
	FC	5	1.3	2.1	0.8
	FS	5	1.6	5.7	0.4
	TPC	5	398.	963.	165.
B32	TC	5	9.7	40.4	2.3
	FC	5	2.3	9.4	0.6
B33M	TC	5	3.0	8.1	1.1
	FC	5	1.5	3.3	0.7
	FS	5	1.7	3.6	0.8
	TPC	5	855.	2439.	300.

TPC = Total Plate Count (This parameter was examined during the June 8 - 12, 1970 survey at the "M" stations, but this parameter has not been discussed in this report or used in the evaluation of recreation use acceptability).

Column headings for Table 1 correspond exactly to those of Table 2.

TABLE 2: SURVEY SUMMARY

Lake: Balsam

Date: August 17 - 21, 1970

Survey: 2nd

Station Number	Parameter	Number of Observations	Geometric Mean (GM) per 100 ml	95% Confidence Limits on GM	
				Upper	Lower
B1M	TC	3	2075.1*	22197.5	194.0
	FC	3	110.5*	636.5	19.2
	FS	4	7.7	71.7	0.8
B2	TC	3	731.9*	19441.1	27.6
	FC	4	72.2	370.7	14.1
	FS	4	1.7	8.8	0.3
B3M	TC	3	2142.0*	556416.0	8.2
	FC	3	50.2	2684.0	0.9
	FS	4	3.5	185.8	0.1
B4M	TC	4	5031.9	23276.1	1087.8
	FC	4	51.0	560.0	4.6
	FS	4	1.7	4.8	0.6
B5M	TC	4	3601.6	18074.1	717.7
	FC	4	83.0	438.6	15.7
	FS	4	3.1	25.9	0.4
B6	TC	4	1030.2	1895.9	559.8
	FC	4	122.3	469.5	31.9
	FS	4	6.4	87.3	0.5
B7M	TC	4	1921.0	28580.5	129.1
	FC	3	32.7*	703.1	1.5
	FS	4	1.7	4.8	0.6
B8M	TC	5	2910.7	18635.8	454.6
	FC	5	28.4	162.0	5.0
	FS	5	4.1	16.0	1.0
B9M	TC	3	2772.6*	492077.0	15.6
	FC	4	211.4	518.0	86.3
	FS	4	2.2	27.7	0.2
B10	FC	5	1345.6	9820.0	184.4
	FC	4	52.6*	4594.7	0.6
	FS	5	3.4	13.4	0.9

Lake: Balsam

Date: August 17 - 21, 1970

Survey: 2nd

Station Number	Parameter	Number of Observations	Geometric Mean (GM) per 100 ml	95% Confidence Limits on GM	
				Upper	Lower
B11	TC	3	1730.7*	123400.4	24.3
	FC	4	61.6	5636.5	0.7
	FS	4	4.6	33.5	0.6
B12M	TC	4	1588.6	18236.3	138.4
	FC	3	148.6*	549.5	40.2
	FS	4	2.4	19.2	0.3
B13M	TC	4	3438.4	21156.0	558.8
	FC	3	71.3*	1124.3	4.5
	FS	4	3.1	28.0	0.3
B14	TC	4	2753.7*	61089.3	124.1
	FC	5	118.5	1091.8	12.9
	FS	5	1.9	5.6	0.6
B15M	TC	4	1848.9	29347.2	116.5
	FC	3	136.0*	1795.0	10.3
	FS	4	2.8	11.7	0.7
B16M	TC	4	941.8*	8218.2	107.9
	FC	5	76.7	313.8	18.8
	FS	5	2.6	14.1	0.5
B17	TC	5	995.2	8273.2	119.7
	FC	5	47.0	299.3	7.4
	FS	5	2.8	19.9	0.4
B18	TC	5	1027.5	5688.2	185.6
	FC	5	17.1	181.7	1.6
	FS	5	4.1	16.7	1.0
B19M	TC	4	733.7*	4662.4	115.5
	FC	5	45.6	945.1	2.2
	FS	5	2.2	8.1	0.6
B20	TC	5	2007.1	9005.2	447.3
	FC	4	16.6*	565.5	0.5
	FS	5	3.6	12.0	1.1

Lake: Balsam

Date: August 17 - 21, 1970

Survey: 2nd

Station Number	Parameter	Number of Observations	Geometric Mean (GM) per 100 ml	95% Confidence Limits on GM	
				Upper	Lower
B21M	TC	4	3227.0	62460.4	166.7
	FC	5	57.4	248.4	13.3
	FS	5	2.0	6.8	0.6
B22M	TC	5	1006.8	7524.2	134.7
	FC	5	35.9	231.8	5.6
	FS	5	4.3	20.0	0.9
B23	TC	5	2012.8	18541.4	218.5
	FC	5	45.1	262.3	7.8
	FS	5	1.5	3.3	0.7
B24	TC	5	793.5	2834.2	222.1
	FC	5	28.2	112.8	7.1
	FS	5	7.2	47.8	1.1
B25	TC	4	2522.1*	46282.2	137.4
	FC	5	7.0	144.5	0.3
	FS	5	3.5	29.0	0.4
B26M	TC	5	564.7	2075.9	153.6
	FC	4	18.5*	63.9	5.4
	FS	5	6.2	28.7	1.3
B27M	TC	3	737.1	8154.2	66.6
	FC	4	41.7	2295.3	0.8
	FS	4	2.2	9.8	0.5
B28M	TC	4	1279.4	15997.7	102.3
	FC	5	12.9	146.3	1.1
	FS	5	5.4	17.0	1.7
B29M	TC	5	3160.5	13982.3	719.0
	FC	5	39.5	320.6	4.9
	FS	5	3.8	17.3	0.8
B30M	TC	4	5258.6	34133.2	810.2
	FC	5	32.3	480.9	2.2
	FS	5	1.5	4.8	0.5

Lake: Balsam

Date: August 17 - 21, 1970

Survey: 2nd

Station Number	Parameter	Number of Observations	Geometric Mean (GM) per 100 ml	95% Confidence Limits on GM	
				Upper	Lower
B31M	TC	3	2277.7	70868.0	73.2
	FC	3	44.5	298.5	6.6
	FS	4	2.4	12.4	0.5
B32	TC	5	4489.1	16758.2	1202.5
	FC	5	49.6	238.5	10.3
	FS	5	1.5	3.3	0.7
B33M	TC	3	2716.3*	140712.5	52.4
	FC	4	31.0	1352.1	0.7
	FS	5	1.5	3.3	0.7
B34	TC	5	1307.3	6529.1	261.8
	FC	5	103.0	311.2	34.1
	FS	5	1.3	2.8	0.6
B35	TC	4	4447.3	20589.8	960.6
	FC	3	37.7	1161.3	1.2
	FS	4	1.9	15.8	0.2

* = count(s) missing because they were too numerous to count.

